Space Weather Technical Forecast

Issued on Wednesday 19 March 2025 at 00:38 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout. Chance G1/Minor Storms days 1-3 (19-21 Mar) due to CME arrivals.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with only C-class flares observed in the past 24 hours. There are currently ten sunspot regions on the visible disc. AR4025 in the northwest is the largest spot at present, with some minor growth within its intermediate spots. AR4028 in the southeast is of similar size, but along with AR4031 in the north near-centre disc showing little change. None of the sunspots are showing any significant magnetic complexity, with most relatively stable.

There are three main CMEs which feature in the forecast, the first is from a filament eruption which occurred in the northeast quadrant, within the vicinity of CH24/-, at 16/2020 UTC, possibly arriving late 19 Mar.

The second CME was from a filament eruption in the northwest around 17/1030UTC, just ahead of AR4025 with ejecta clearly leaving to the west, though a faint halo can be seen later on Stereo-A imagery, possibly arriving 20 Mar.

The third CME was associated with the 17/1930UTC M1.0 flare and filament eruption from a region of plage in the northeast, perhaps arriving early on 21 Mar.

No other Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1, were at near background levels, around 400km/s, increasing to elevated levels from 18/1615 UTC, due to the arrival of a glancing CME, peaking at 570km/s. Solar winds have since declined to background levels. Density was mostly average to below average. Interplanetary Magnetic Field, Bt, was weak to moderate, peaking at +12nT, with the north-south component, Bz, weak to moderate, ranging between +7 and -10nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) was Moderate to High, with a peak of 3090pfu at 18/1330 UTC. The 24-hour fluence was above the Active (1e8 integrated pfu) at first, before declining back to below the Active threshold at 4.03e7 integrated pfu observed at 19/0000 UTC.

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Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with an ongoing chance of further isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are three main CMEs which feature in the forecast in the coming days (19-21 Mar). Solar winds are likely to remain mostly at slow levels with slightly elevated or elevated enhancements probable due to forecast CME arrivals. Quiet to Unsettled activity with a chance of G1-G2/Minor-Moderate storms days 1-3 (19-21 Mar) should any of the three possible CMEs arrive and/or combine.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a slight chance of enhancement should there be any larger flares. High energy electron flux is expected to continue to reach high levels at the diurnal maxima. Electron (1e8 integrated pfu) fluence should remain below the Active threshold throughout the period.

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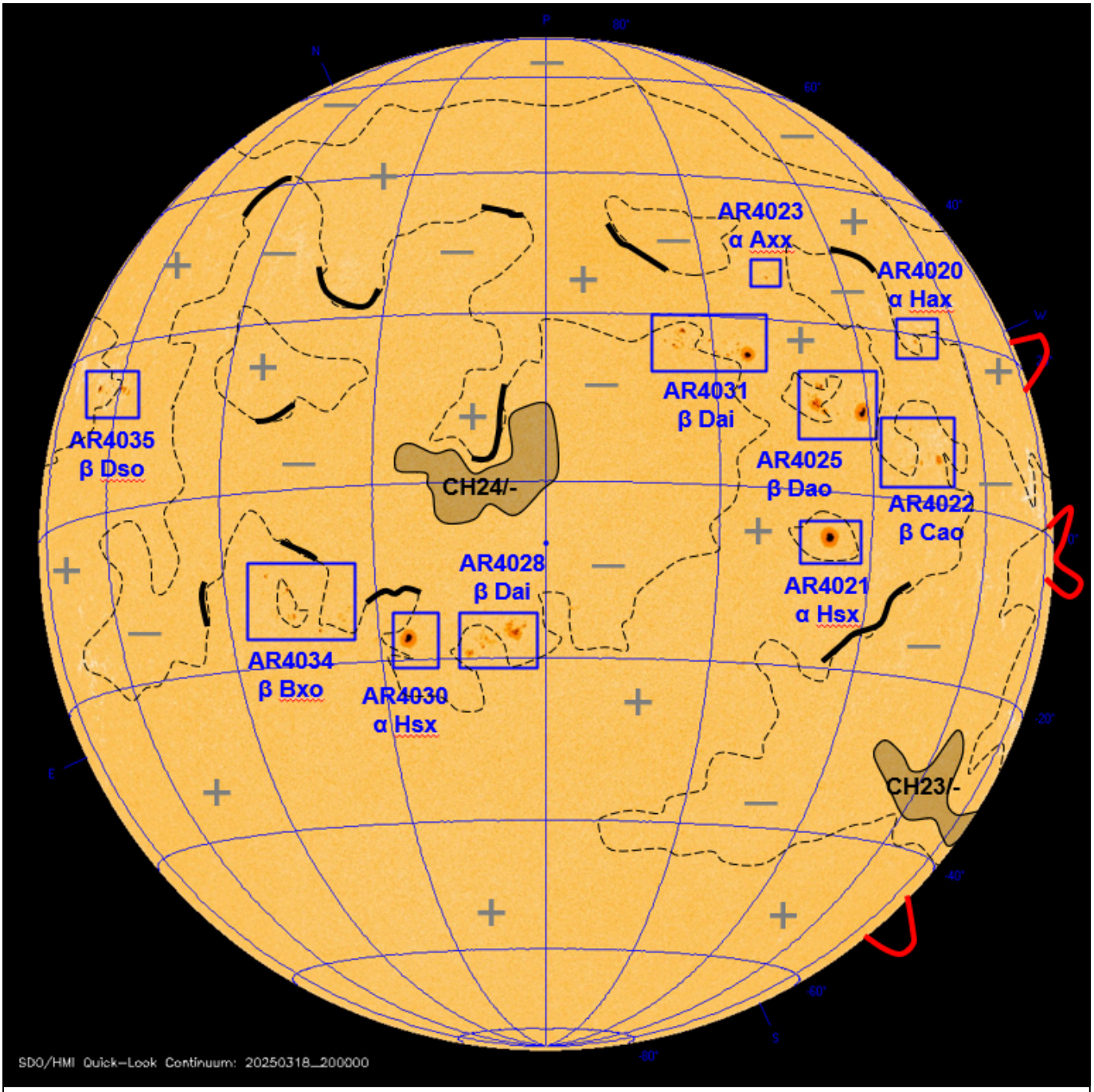
Figure 1: Solar synoptic chart valid 18/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are three main CMEs which feature in the forecast, the first is from a filament eruption which occurred in the northeast quadrant, within the vicinity of CH24/-, at 16/2020 UTC. This produced a partial halo CME in coronagraph imagery, with an associated shock evident. This has been analysed, as results suggest a glancing blow arriving at Earth either late on day 2 (19 Mar) or early on day 3 (20 Mar). Given the filament was near CH24/-, there may have been some deflection towards the south and west, which is currently under consideration.

The second CME was from a filament eruption in the northwest around 17/1030UTC, just ahead of AR4025 with ejecta clearly leaving to the west, though a faint halo can be seen later on Stereo-A imagery. A new sunspot formed in this location shortly after.

The third CME was associated with the 17/1930UTC M1.0 flare and filament eruption from a region of plage in the northeast. This CME mostly travelled north, but once again may have an Earth Directed component, perhaps arriving early on day 4 (21 Mar).

Otherwise, the fast wind enhancement from CH22/- has now eased with solar wind speeds near background at around 400km/s with no significant coronal hole enhancements expected in the period. Quiet to Unsettled activity is expected initially, with a chance of G1-G2/Minor-Moderate storms days 1-3 (19-21 Mar) should any of three possible CMEs arrive and/or combine.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	30	30	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
17/0253	Partial	Filament Eruption	Northeast	580	19/2100	A large shock associated with this CME.
17/1809	Partial	Filament Eruption	Northwest	600	20/1800	Low confidence on exact timing due to interactions with other CMEs. May combine.
18/0215	Partial	Filament Eruption	Northeast	520	21/0100	Low confidence. Chance of a glance.

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Figure 2: MOSWOC Enlil showing numerous CMEs arriving in the coming days (19-21 Mar).

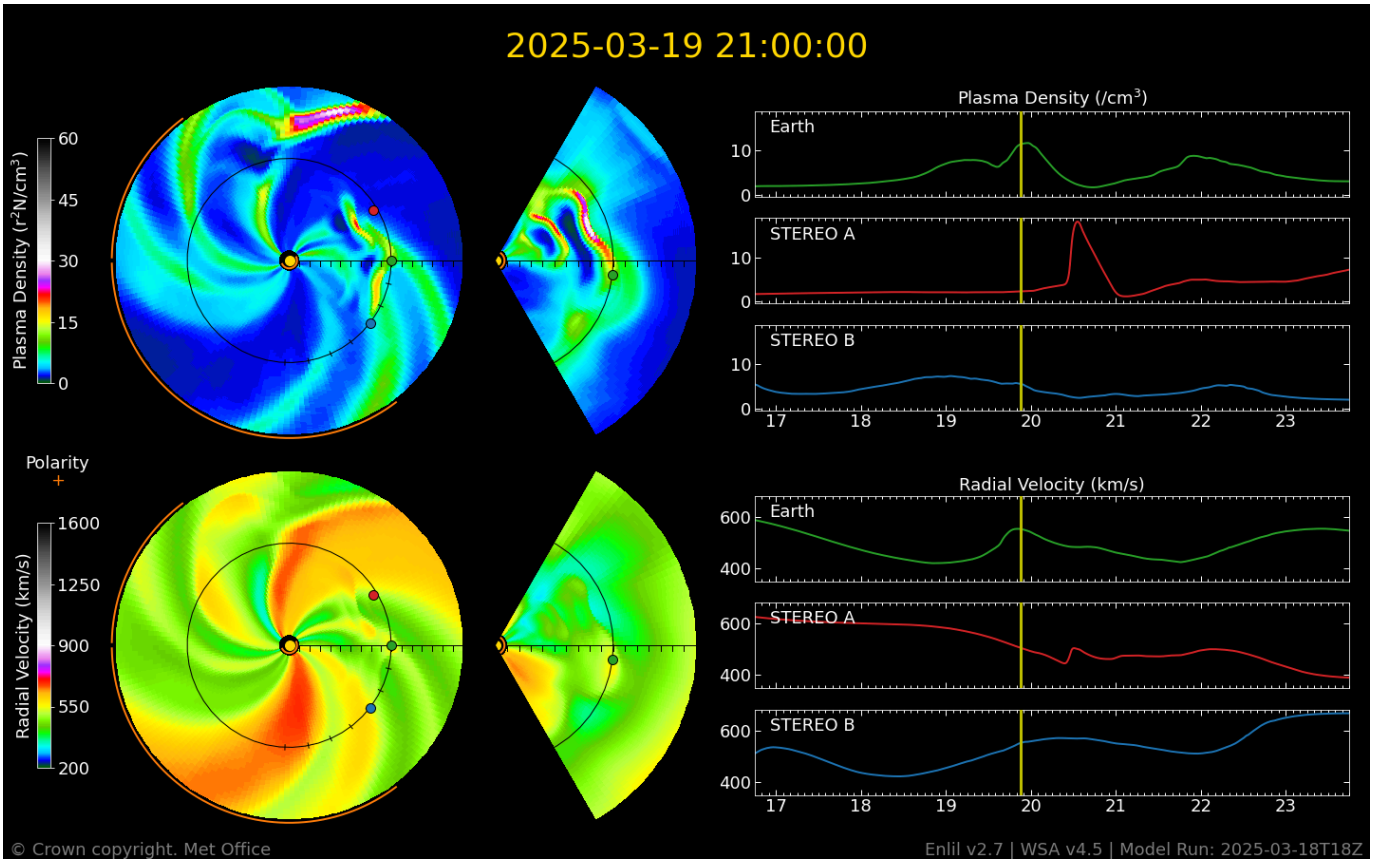

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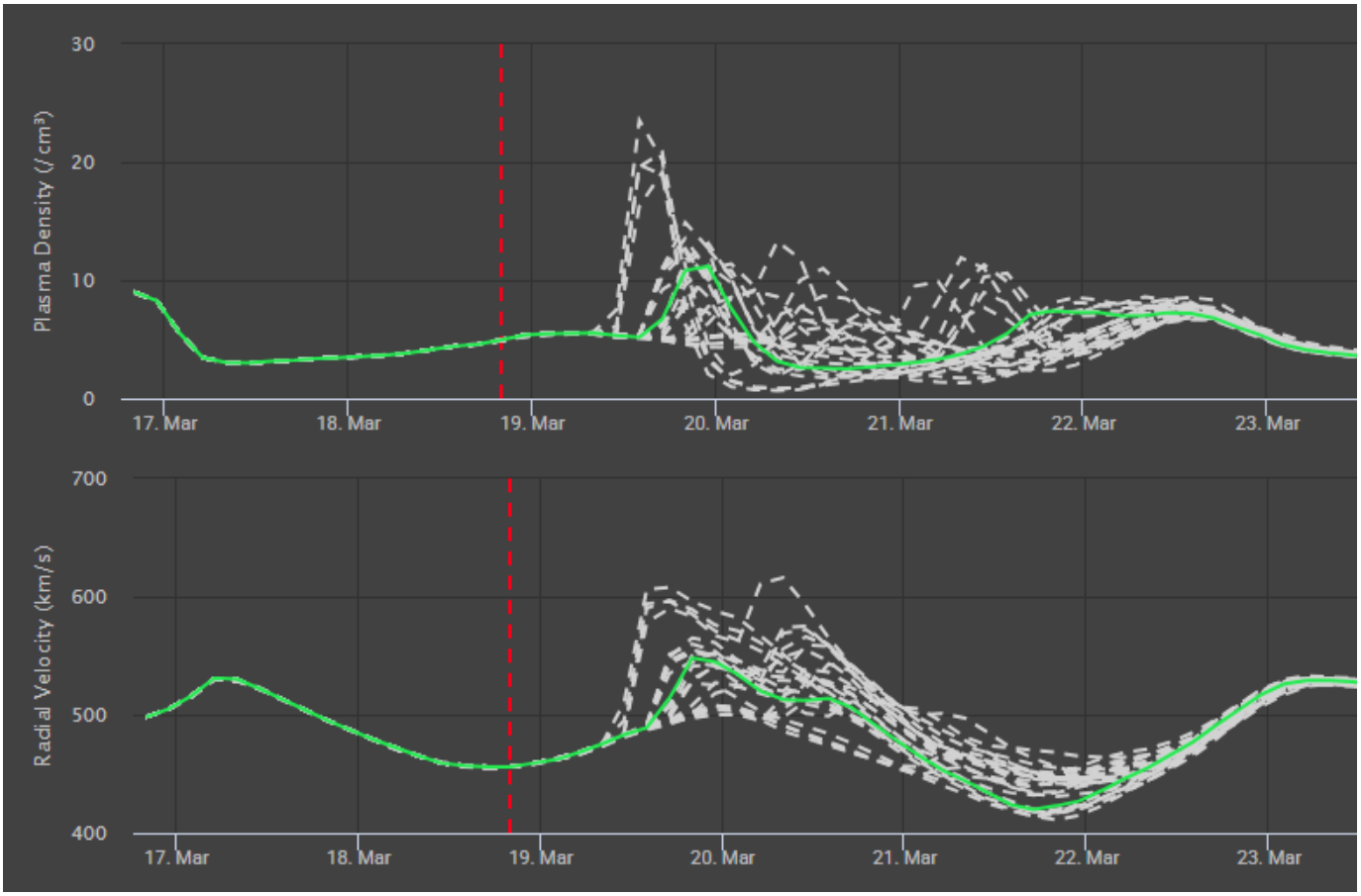
Figure 3: MOSWOC Enlil ensemble shows possible arrival times of forecast CMEs.



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Radio Blackouts - X-Ray Flares

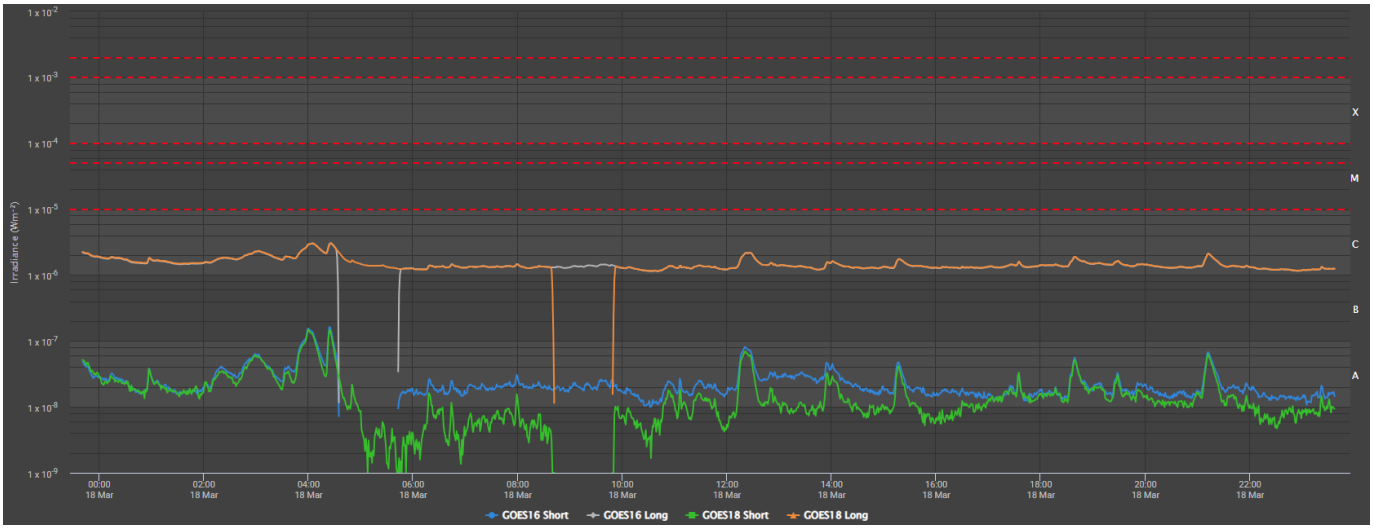
Solar activity has been Low, with only C-class flares observed in the past 24 hours.

There are currently ten sunspot regions on the visible disc. AR4025 in the northwest is the largest spot at present, with some minor growth within its intermediate spots. AR4028 in the southeast is of similar size, but along with AR4031 in the north near-centre disc showing little change. None of the above spots are showing any significant magnetic complexity, with the remainder of the spots, smaller and stable.

Low to Moderate activity is expected, with a chance of further M-class flares.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	40	40	40	40
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 4: GOES16-18 X-Ray Flux for the past 24 hours.



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is expected to remain at background levels, with only a slight chance of enhancement due to the current inactivity and magnetic simplicity of the small regions on the Earth-facing disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

GOES16 High energy (>2MeV) Electron flux has been varying between Moderate and High on the satellites diurnal cycle, as a result of the recent connection to coronal hole fast winds, and the subsequent outward expansion of the charged Van Allen belts as this wind eases. Flux is expected to continue varying diurnally between Moderate and peak High, but with both the period of High flux and peak values are expected to gradually decrease through the period. With possible CME arrival/s due 19-21 March, this may serve to clear some electrons from their orbits, reducing flux on subsequent days.

The associated 24 hour fluence has recently returned to below threshold levels, due to the arrival of a glancing CME. MOSWOC REFM shows the fluence should remain below the Active threshold throughout the remainder of the period, especially with possible CMEs arrivals in the coming days.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^8	Yes	10	5	5	5
Very Active	≥ 2 MeV ≥ 1×10^9	No	1	1	1	1

Figure 5: GOES16 Electron Flux over the past 24 hours.

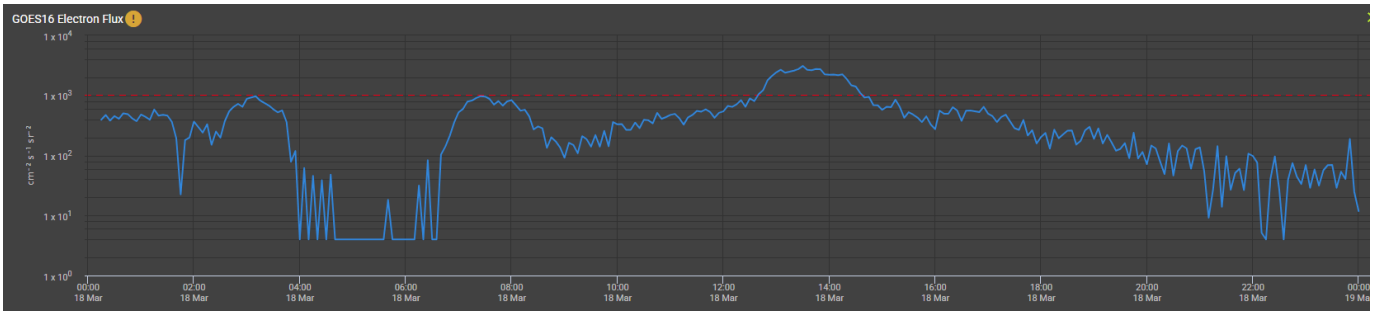

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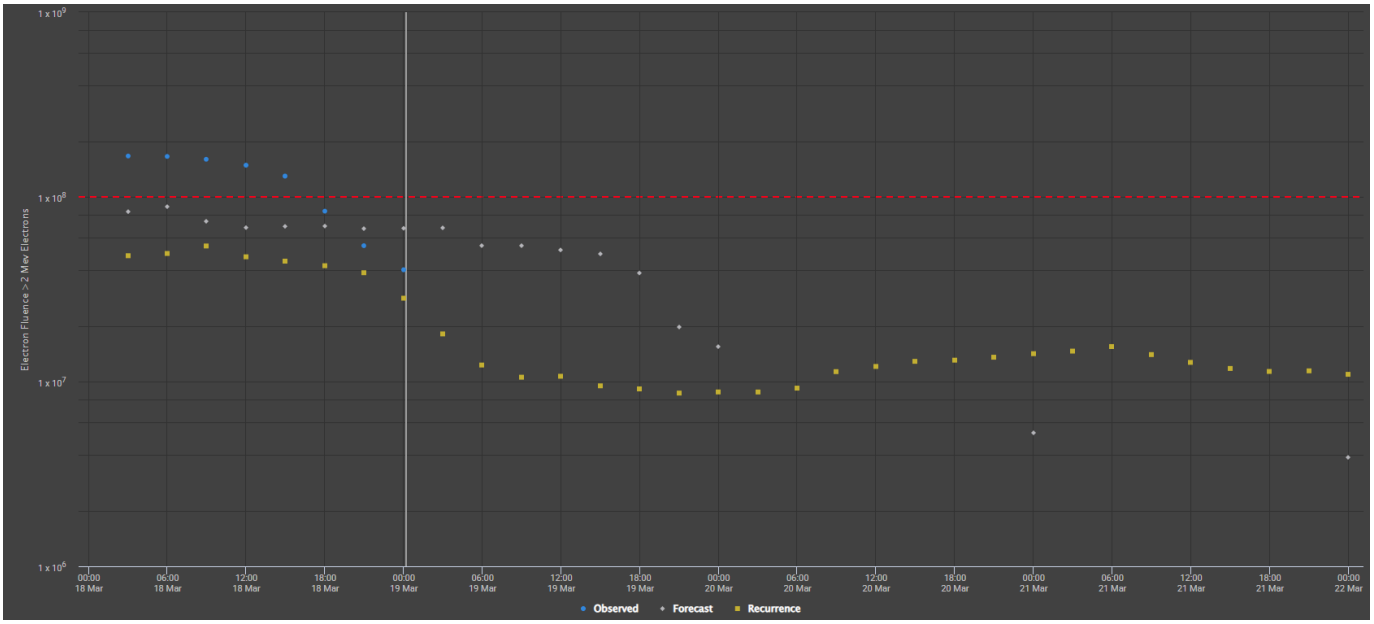
Figure 6: MOSWOC REFM electron fluence - started the 24 hour period above the Active threshold.



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